



The National Capital Region is home to harperella (*Ptilimnium nodosum*), a federally endangered plant species with only 14 populations known worldwide. Harperella is a short, mostly annual (i.e., it lives only one year) member of the carrot family with a small cluster of white flowers. Its hollow, needle-like leaves blend into the surrounding grasses and rushes, making it inconspicuous. Harperella is found in seasonal ponds and along streams in western Maryland, Arkansas, North Carolina, Virginia, and West Virginia.

# DECIPHERING LIFE'S ESSENTIALS

for A RARE PLANT

Sunny, cobble bars in gravelly streams that become exposed during mid- to late summer are ideal sites for population establishment. But this small plant is caught in a “habitat dilemma:” the habitat is created when strong stream currents strip away vegetation, including harperella, and toss gravel around. However, when the currents subside, perfect places are left behind for harperella seed dispersal and germination, which are essential to its survival.

Harperella is a pioneer species on these freshly exposed gravel cobble bars. But if the flooding and currents are too strong, last too long, or occur too frequently, the habitat and plants are washed away before seed germination. Many of these riverine habitats have been altered by development that has hardened surfaces and removed the trees, which changes the hydrology of an area. Because of the increase in development, rain that falls on open or paved surfaces rushes more





*Cobble bars in gravelly streams are ideal sites for harperella.*

swiftly into streams and then into the Potomac River. This change increases the frequency and velocity of the high water events. These “flashy” or sudden and frequent high water events also increase erosion, which in turn contributes more sediment to the water. As the sediment settles out of the water and onto vegetation and gravel bar alike, it robs harperella of sunlight by covering its leaves with mud and algae (MDNR 1995). Increased water impoundments or retention sites in the watershed coupled with more dramatic draw-downs of the Potomac River by consumer use may further stress this rare plant, which needs damp sand and gravel to grow.

Collections of harperella have been made for nearly a century in the National Capital Region. Harperella has been documented at Harpers Ferry National Historical Park, but it has not been seen there for more than 25 years. Harperella was found on three separate, recent occasions on cobble bars along the Potomac River within the Chesapeake and Ohio (C&O) Canal National

Historical Park. Unfortunately, following each discovery, the species was extirpated (lost) because of severe flooding. The loss of these subpopulations and their habitats is ecologically important because these are the most northerly harperella populations.

As a federally endangered species, harperella is one of the highest conservation priorities for C&O Canal National Historical Park and the National Capital Region. In 1988, the species was federally listed as endangered by the U.S. Fish and Wildlife Service. Threats to the species and its habitat are severe due to hydrologic alterations caused by landscape use changes, the spread of non-native invasive plant species, and the Park’s recreational use by more than 3 million people visiting annually. All of these factors contribute to habitat degradation. The U.S. Fish and Wildlife Service Recovery Plan outlines tasks for the restoration and recovery of harperella populations throughout the eastern United States (FWS 1990).

The Nature Conservancy and the Maryland and West Virginia State Natural Heritage

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Programs surveyed extensively for harperella between 1981 and 1994. Botanists found populations of harperella along five streams and the Potomac River (Bartgis 1997). These surveys revealed that harperella remains a very local species within the Potomac River drainage.

Dr. Elizabeth Wells, a botanist at George Washington University, began restoration efforts in 2001 at the C&O Canal National Historical Park, working first to pinpoint when harperella is most vulnerable and what has the greatest effect on its survival. The National Capital Region funded Dr. Wells’s preliminary survey to locate harperella populations and to assess their size and vigor. Dr. Wells surveyed the shore of the Potomac River along the C&O Canal from Cumberland to Williamsport, Maryland (Wells 2002a). Although she did not find harperella populations on Park land, four populations exist in the Sideling Hill Creek Wildlife Management Area, Maryland. From these populations, Dr. Wells collected three hundred seeds in fall of 2001 to use in germination and transplant experiments.



*Needle-like leaves of harperella make it inconspicuous.*

Dr. Wells sent two hundred harperella seeds for cryopreservation (freezing in liquid nitrogen) to the USDA National Center for Genetic Resources Preservation, Fort Collins, Colorado. The Center has joined with the National Park Service to preserve the seeds of our parks’ most imperiled plants. The seeds are protected and available for use in future reintroductions.

The goal of Dr. Wells’s research is to decipher the narrow range of unique requirements for harperella’s survival in order to establish new populations on Park land and to provide accurate information about the species, increasing the ability of C&O Canal National Historical Park to establish and protect harperella populations. Dr. Wells conducted work on harperella’s breeding requirements

in the growth chamber and greenhouses at George Washington University. She hand pollinated flowers to ensure seed set. Dr. Wells conducted greenhouse and growth chamber trials to identify the micro-environmental parameters needed for germination of harperella seeds and growth of young plants. Additionally, she carefully recorded details about the life cycle of harperella.

Harperella lives a life of moderation when it comes to flooding. This study has demonstrated that harperella tolerates flooding to moderate depths and for moderate lengths of time. The consequences of seasonal flooding during various stages of harperella’s life cycle are not well understood. Harperella appears to require some flooding during the winter and spring to scrape away plant competitors on the gravel bars. Flooding during seed maturation in late summer and autumn has mixed consequences for harperella. Minor floods of low volume have a seemingly beneficial role in seed dispersal through the establishment of new populations downstream. Yet, major floods of extended duration during the fall months kill the seeds and wash plants away.

Over two years, Dr. Wells transplanted small plants and planted seeds into eight marked

*Dr. Wells, George Washington University, conducts greenhouse studies of harperella.*





plots at several sites along the western side of the Potomac on land managed by the C&O Canal National Historical Park (Wells 2002b). Because harperella plants require specific site characteristics, including full sun, erosion protection, and scouring by water, few sites are ideal for transplants. During the first year, Dr. Wells transplanted young harperella seedlings and planted seeds into open plots cleared of all vegetation. The National Capital Region Exotic Plant Management Team worked with the investigator to eradicate non-native invasive plants from each of the plot sites. However, flooding wiped out the plots, killing the harperella.

The following year, Dr. Wells compared the survival of young harperella plants in four plots with all vegetation removed to four plots with intact vegetation. Thick stands of a herbaceous plant, American water-willow (*Justicia americana*) dominated the vegetated plots. American water-willow is a small, woody, deeply rooted plant that is common along the rocky Potomac shores. The Exotic Plant Management Team assisted Dr. Wells again by removing non-native invasive plants.

Relatively speaking, harperella did survive better in plots with American water-willow than in areas with no surrounding vegetation. The greater survival of harperella

suggests that American water-willow may offer protection for the young transplants from the rapidly moving water. In one plot where the American water-willow had been cut to the ground, the entire plot was badly eroded, a major flood wiped out most of the water-willow plants and all of the harperella transplants. Eventually, severe flooding by three major flood events spaced three weeks apart killed the harperella in all plots demonstrating the incredible challenge of protecting this vanishing plant.

Harperella makes new populations by its seeds and plantlets washing downstream (TNC 1993). Plantlets are small pieces of

*Transplantation studies at C&O Canal National Historical Park have yielded very low survival rates.*

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broken plants that root at leaf nodes. This nodal rooting happens after harperella is submerged in shallow water for a while, and it is a form of vegetative reproduction. Dr. Wells has observed nodal rooting in the wild populations. If a small flood event happens during the late winter or early in the summer, harperella plantlets may be a primary means of dispersal instead of its very small, hard-coated seeds (less than 0.08 inch (2 mm)). Dr. Wells is continuing this restoration project by investigating harperella vegetative reproduction in the greenhouse. She will collect additional viable harperella seeds and locate other suitable sites for the reintroduction of young plants on the C&O Canal and off of the main stem of the Potomac River.

The possibility of losing all our harperella populations forever is real. Understanding the ecological dilemmas that lead to the loss of such plants may help us understand the effects of broader ecological changes in the Potomac River watershed. Although few of us have seen this small plant, its survival could foretell the future for other residents of the Potomac.

## References

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*Harperella is a federally endangered species.*



## CENTER FOR URBAN ECOLOGY

### Exotic Plant Management

The spread of invasive non-native plants is one of the major threats to the survival of harperella and other endangered native plants. The Exotic Plant Management Team at the Center for Urban Ecology is responsible for controlling invasive plants within the parks of the National Capital Region. As one of seventeen established teams within the National Park Service, the Exotic Plant Management Team inventories and maps non-native vegetation and develops strategies for controlling these plants. Regional management of invasive plants species encompasses approximately 65,000 acres (26,300 hectares) that span the District of Columbia, Maryland, Virginia, and West Virginia. Due to the numerous and varied habitats of the National Capital Region, eradication methods and/or strategies for control are developed specifically for individual species and sites. The successful management and restoration of disturbed areas are accomplished through partnerships between the Exotic Plant Management Team, park staff, and numerous volunteer groups that are concerned with invasive exotic plants. The Exotic Plant Management Team engages in an active outreach program, providing biological and control information to interested volunteers, community groups, and land management professionals.